REMARKS

This paper is presented in response to the final official action dated January 25, 2008, wherein: (a) claims 1, 2, 4-7, 9-15, and 17-22 were pending; and, (b) claims 1, 2, 4-7, 9-15, and 17-22 were rejected under 35 USC § 103(a) as obvious over Medoff et al. U.S. Patent No. 6,207,729 ("Medoff") in view of Sato U.S. Patent No. 4,619,962 ("Sato") and Polovina U.S. Patent No. 3,637,571 ("Polovina").

Reconsideration and withdrawal of the rejection are respectfully requested in view of the following remarks.

Attached hereto are two excerpts from the *Kirk-Othmer Encyclopedia of Chemical Technology* (3rd ed. (1980)). The excerpts are relevant to technical issues addressed in more detail below, including the function of a heat stabilizer polymeric additive (vol. 12) and the physical properties of polyamides (vol. 18).

I. Brief Summary of the Amendments to the Claims

Claims 1, 10, 18, and 22 have been amended for clarity. No change in claim scope is intended or effected by these amendments, and amendments are intended to present the rejected claims in better form for consideration on appeal.

Claim 6 has been canceled.

Accordingly, the applicants submit that the foregoing amendments are proper and may be entered. 37 CFR 1.116(b)(2).

II. The 35 USC § 103(a) Rejections Are Traversed

Claims 1, 2, 4-7, 9-15, and 17-22 were rejected as obvious over Medoff in view of Sato and Polovina. *See* p. 6-10 of the action. The applicants traverse the obviousness rejection as set forth below.

A. Proper Basis for an Obviousness Rejection

The PTO bears the initial burden of presenting a *prima facie* case of obviousness. *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992); *see also* MPEP § 2142 (8th ed., rev. 6, September 2007). A *prima facie* case of obviousness requires that each and every limitation of the claim is described or suggested by the prior art, or would have been obvious based on the knowledge of those of ordinary skill in the art. *In re Fine*, 837 F.2d 1071, 1074 (Fed. Cir. 1988). Further, "rejections

on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006). Thus, any analysis supporting an obviousness rejection should be made explicit and should "identify a reason that would have prompted a person of ordinary skill in the art to combine the elements" in the manner claimed. *KSR Int'l Co. v. Teleflex, Inc.*, 127 S.Ct. 1727, 1739 (2007).

When evaluating the teachings of the applied references, each reference must be considered in its entirety (i.e., as a whole), including portions that would lead away from a claimed process. *W.L. Gore & Associates, Inc. v. Garlock*, Inc., 721 F.2d 1540 (Fed. Cir. 1983); MPEP § 2141.02(VI). If a proposed combination would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 810 (CCPA 1959); MPEP § 2143.01(VI).

B. Disclosure of the Applied References

Medoff is generally directed to texturized cellulosic (and lignocellulosic) materials and compositions using the same. Cut cellulosic material (e.g., flax, hemp) is sheared with a rotary cutter to form a texturized fibrous material generally having a length/diameter ratio of at least about 5. Medoff, 1:26-40, 3:20-37. The texturized fibrous material can be combined with a resin to form a strong, lightweight composite. *Id.*, 4:26-27. Polyamide is generically disclosed in a list of suitable resins, although all of the example composites are formed using HDPE. *See id.*, 4:48-56 (listing different resins), 7:8-9:14 (Compositions 1-7 of Example 2). Various conventional additives can be added to the composite, for example a heat stabilizer. *Id.*, 5:5-9. The composite can be formed and pelletized, for example using an extruder at less than about 190 °C to both melt the resin and mix the blend of resin and texturized fibrous material. *Id.*, 5:50-58. The composite can be used as a wood substitute and can be formed into a variety of rigid and/or inelastic articles. *See id.*, 6:14-46 (listing potential articles formed by the composite), 8:17-9:15 (Compositions 4-7 of Example 2 having an ultimate elongation of less than 5%).

Sato is generally directed to thermoplastic polymer compositions. Sato is particularly directed to a polymer blend of crystalline polyamide and a carboxylated

synthetic rubber useful in the fabrication of low-permeability hoses. Sato, abstract. The polyamides generally include nylons with melting points ranging from 160 °C to 230 °C (e.g., nylon-6 at about 223 °C, nylon-11 at about 190 °C, and nylon-12 at about 179 °C).[1] *Id.*, 2:8-21. The synthetic rubber is formed from butadiene, (meth)acrylonitrile, and α,β-unsaturated carboxylic acid (e.g., acrylic) monomers. *Id.*, 2:22-33.

Sato's composition also includes two inorganic additives. A first additive is a metal halide (e.g., lithium chloride). *Id.*, 2:39-41. The halide can influence the melting point of the polyamide and/or promote the compatibility of the polyamide and the synthetic rubber. *Id.*, 2:43-47. A second additive is an oxide, a hydroxide, or a peroxide of a divalent metal. *Id.*, 2:60-63. The metal forms ionic crosslinks with the carboxylic acid groups in the synthetic rubber. *Id.*, 2:65-68.

Sato's composition is formed by mixing (e.g., in an extruder) the various components at a temperature sufficient to melt the polyamide, for example between about 180 °C and about 230 °C. *Id.*, 3:55-61, 4:1. The composition can then be molded into a shaped article at a temperature between about 180 °C and about 220 °C. *Id.*, 4:14-17. Sato's examples are all prepared using a mixer at 220 °C to melt nylon-11 as the polyamide and using a press at 200 °C to mold the mixed composition into sheets. *Id.*, 4:42-60. All four components (i.e., two polymers and two additives) are required to achieve the balance of desirable mechanical and physical properties that make the resulting composition useful as a flexible hose material. *See id.*, 3:1-3 (describing the contributions from the polyamide and the synthetic rubber), 4:18-35 (describing desirable properties and the imbalance resulting from the omission of the additives), 4:42-8:15 (examples illustrating the balance of properties, for example Experiments 24-27 having a tensile strength somewhat less than the pure polyamide (Experiment 28) but having a % elongation much higher than the pure polyamide)

Polovina is generally directed to a process for preparing thermoplastic resin-additive compositions. Polovina is cited for its teaching of a masterbatch process in which additives are added to a polymer that is then pelletized in an intermediate step prior to molding. Office action, p. 3 and 9.

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[1] *See Kirk-Othmer Encyclopedia of Chemical Technology*, 3rd ed. (1980), vol. 18, p. 360 (listing melting temperatures of various commercial polyamides).

C. Presentation of a *Prima Facie* Case of Obviousness

The action asserts that it would have been obvious to "incorporate the methods of Polovina and Sato into that of Medoff." Office action, p. 3. The action essentially combines the references by forming the polyamide-containing polymeric material of Sato to be used as a resin in the composite composition of Medoff. *Id.*, p. 3-4. Polovina is cited merely for the teaching of a masterbatch process used to form the intermediate polyamide-containing polymeric material of Sato (i.e., which already contains a metal halide) into pellets prior to being used in Medoff's composite. *Id.*, p. 9.

Accordingly, the action effectively asserts that it would have been obvious to serially combine the processing steps of Sato, Polovina, and Medoff to predictably yield the claimed process. However, this rationale for a *prima facie* case of obviousness still relies on "a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does." MPEP § 2143(A) (citing *KSR*). Absent such a reason, "this rationale cannot be used to support a conclusion that the claim would have been obvious to one of ordinary skill in the art." MPEP § 2143(A).

As set forth in detail below, the applicants respectfully submit that the applied references fail to support a *prima facie* case of obviousness. Specifically, the proposed combination of Sato, Polovina, and Medoff impermissibly changes the principle of operation of the underlying references. Further, even if combined in the manner proposed by the action, the applied references fail to teach or suggest all recited limitations. Additionally, the action fails to provide adequate reasoning supporting its proposed combination of references.

1. Principle of Operation of the Applied References

Sato and Medoff are not properly combinable because each reference relates a composition whose mechanical properties are incompatible with the functional goals of the other reference. Accordingly, each reference teaches away from its combination with the other.

Medoff's composites are generally strong, rigid materials for use as a structural component of various articles. *See* Medoff, 6:14-46 (indicating the composite's suitability as a "wood substitute" and listing numerous rigid articles that

can be formed therefrom). Even though some of the disclosed uses for the composite include flexible structures, the formed articles are nonetheless inelastic. *See id.* (listing, e.g., carpets and rugs as possible composite articles). Further, all of the example composites tested were inelastic, having an ultimate elongation of less than 5%. *See id.*, 8:17-9:15 (Compositions 4-7 of Example 2).

In contrast, Sato's polymer compositions are flexible and more elastic. The polymer is intended for use as a flexible hose material. Sato, 4:27-29. Further, the examples representing preferred formulations have ultimate elongation values of about 300%. *See id.*, 4:42-8:15 (summarizing example data in Tables I-VI).

Thus, it would be inappropriate to use the flexible, elastic material of Sato as a resin material to form the matrix of Medoff's strong, rigid composite (i.e., as proposed by the action). Specifically, Sato adds a carboxylated synthetic rubber to its polyamide-based polymer composition to improve the elastic properties of the resulting polymer *at the expense of* the polymer's strength. Conversely, Medoff adds its texturized fibrous material to a rigid, inelastic polymer matrix to *increase* the resulting composite's strength. Accordingly, serially combining Sato and Medoff impermissibly changes the principle of operation of Medoff (i.e., the primary reference being modified) by changing the basic mechanic characteristics of the composite formed in Medoff. *In re Ratti*, 270 F.2d 810.

In view of the foregoing, the applicants request reconsideration and withdrawal of the obviousness rejection.

2. Suggestion of the Recited First Mixture

Each of independent claims 1, 10, and 18 recites a first mixture consisting essentially of a thermoplastic polymer having a melting temperature of 200° C or above and at least one of a particular metal halide salt.

The transition phrase "consisting essentially of" applied to the recited first mixture excludes additional components that "*materially* affect the *basic* and *novel* characteristic(s)" of the recited process. *In re Herz*, 537 F.2d 549, 551-52, (CCPA 1976) (emphasis in original). As explained in the application specification, fiber-reinforced polymeric materials are useful in structural applications, providing a strong, light material. Application specification, ¶ 5, ¶ 6. An advantage of the recited process is that it allows the use of a polymer matrix that has advantageous mechanical properties, but that also has a high melting point, which high melting

point would otherwise degrade natural fibers processed in a melt of the polymer matrix. *Id.*, ¶ 41. As a result, natural fiber-reinforced composites according to the disclosure have substantially improved tensile and flexural properties relative to the neat polymer matrix material, but with the additional benefit of biodegradability (i.e., based on the use of natural fibers). *See id.*, ¶ 86 (Table 4 comparing neat nylon-6 with a composite using a nylon-6/lithium chloride matrix and hemp fiber reinforcements); Section II.D below.

The action relies upon Sato's disclosed polymer composition for the teaching or suggestion of the recited first mixture. Office action, p. 3. However, Sato's polymer composition includes a substantial amount of a carboxylated synthetic rubber as an essential component in addition to a polyamide. The synthetic rubber is excluded by the "consisting essentially of" transition, because the synthetic rubber limits the use of Sato's polymer composition as a composite matrix, both because the polymer has a reduced strength (i.e., relative to the neat polyamide) and has elastic properties making it unsuitable for structural applications.

Accordingly, even if combined as proposed in the action, the applied references fail to teach or suggest all recited limitations, and there is no *prima facie* case of obviousness. *In re Fine*, 837 F.2d 1071. Thus, the applicants request reconsideration and withdrawal of the obviousness rejection on this additional, independent basis.

3. Reason Prompting the Proposed Combination

Each of independent claims 1, 10, and 18 recites a thermoplastic polymer having a melting temperature of 200 °C or above and a first mixture whose melting temperature has been lowered to less than 200 °C by adding at least one of a particular metal halide salt to the thermoplastic polymer.

The action asserts that the skilled artisan would have selected a polyamide from Sato having a melting temperature of 200 °C or above and then added a sufficient amount of a metal halide salt to reduce the melting temperature below 200 °C because "suppression of melt temperature would be recognized as a desirable benefit of the additives regardless of their use with or without cellulose of other materials." Office action, p. 9. Further, the action reasons that "in view of Medoff's specific suggestion to provide heat stabilizers (5:7), it is submitted that heat

degradation is a recognized problem, and that Sato provides an additive that would act as a heat stabilizer." *Id.*

The applicants respectfully disagree with this reasoning.

Neither the applied references nor the knowledge of the skilled artisan suggests the desirability of the recited limitations related to melting temperatures both above and below 200 °C. Medoff does not suggest the desirability of using a polyamide with a melting temperature of 200 °C or above, in particular because some common polyamides have melting temperatures below 200 °C in their neat form. *See* Sato, 2:8-21 (disclosing the melting point of common commercial nylons as ranging from 160 °C to 230 °C; *Kirk-Othmer*, vol. 18, p. 360 (listing the melting temperatures of nylon-11 and nylon-12 at about 190 °C and 179 °C, respectively). Thus, Medoff's generic disclosure of "polyamides" without any specifically disclosed nylons combined with its disclosure of an extruder temperature of about 190 °C or less would simply suggest the use of nylons having melting temperatures at about 190 °C or less in their neat form. Additionally, the use of nylon-11 in each of Sato's examples indicates a strong preference for this polyamide, and the skilled artisan combining Medoff and Sato would simply use nylon-11 (i.e., a thermoplastic polymer that *does not* have the recited melting temperature of 200 °C or above).

Further, even if a different polyamide were selected from Sato (e.g., nylon-6 having a melting temperature of about 223 °C), the skilled artisan still would not have been prompted to combine the elements of Sato and Medoff in the manner claimed. While Sato discloses that its metal halide additive affects the melting point of its polyamide, Sato emphasizes that the important contribution of the metal halide additive is to the balance of desirable physical and mechanical properties of the resulting composite. *See* Section II.B above. Thus, the skilled artisan optimizing this hypothetical combination would be concerned with physical/mechanical properties of the final material (i.e., and *not* the melting temperature of the material during processing), and the skilled artisan would *not* arrive at the recited process.

Additionally, Medoff's disclosure of a heat stabilizer is irrelevant to the recited process. As is commonly understood in the art, a heat stabilizer is an additive that protects a polymer composition (in particular those containing chlorine or bromine) from degradation of its polymer properties (e.g., discoloration, reduction of mechanical properties) resulting from prolonged thermal exposure. *Kirk-Othmer*

Encyclopedia of Chemical Technology, 3rd ed. (1980), vol. 12, p. 225-226. Thus, heat stabilizers in general are unrelated to the melting temperature of the polymer composition, and Medoff's disclosure of a heat stabilizer in no way provides a reason to incorporate the metal halide of Sato.

Accordingly, the action fails to provide a reason prompting the skilled artisan to combine the references in the manner claimed. *KSR*, 127 S.Ct. at 1739; MPEP § 2143(A).

4. Conclusion

For the foregoing reasons, the applicants submit that each of the three reasons provided above is independently sufficient to preclude a conclusion that the pending claims are *prima facie* obvious over Medoff in view of Polovina and Sato. Accordingly, the applicants request reconsideration and withdrawal of the obviousness rejection.

D. Objective Evidence of Non-Obviousness

Notwithstanding the foregoing discussion regarding the lack of a *prima facie* case of obviousness, the applicants further submit that the pending claims are allowable on the basis of objective evidence of non-obviousness in the form of comparative data present in the application specification.

The application specification presents tensile and flexural properties for composites prepared according to the recited processes. The application examples were performed using a nylon-6 thermoplastic polymer, a variable amount of lithium chloride metal salt, and a variable amount of hemp natural fiber. Application specification, ¶ 86 (Table 4). The tensile and flexural properties of the resulting composites (and a neat nylon-6 reference) are summarized in Table 1 below.[2] Table 1 also includes comparative data from the examples of Medoff[3] and Sato[4].

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[2] In Table 1, the application specification data entries are labeled "Spec. 'n'", where "n" represents the nth row entry of specification Table 4.

[3] Compositions 1, 2, 3, and 7 of Example 2 are presented for comparison because they are the most similar to application examples. Specifically, the present examples of Medoff include a polymer matrix and a natural fiber reinforcement, but do not include a calcium carbonate inorganic filler (i.e., similar to the application examples).

Table 1. Comparative Mechanical Properties

	Spec. 1	Spec. 7	Spec. 8	Spec. 3	Spec. 4	Medoff	Sato
Polymer	Nylon-6	Nylon-6	Nylon-6	Nylon-6	Nylon-6	HDPE	Nylon-11
Metal Salt (wt.%)	–	3.0	3.0	3.5	3.5	–	1.0-4.8
Natural Fiber (wt.%)	–	30	40	15	30	40-59	–
Tensile Str. (MPa)	62.7	70.0	76.0	67.6	71.6	n/a	14.7-35.3
Tensile Mod. (GPa)	2.3	5.4	6.7	3.5	5.1	n/a	n/a
Flexural Str. (MPa)	84.5	120.7	120.8	123.3	128.4	53.8-78.6	n/a
Flexural Mod. (GPa)	2.2	5.8	7.8	4.5	6.5	4.3-5.0	n/a

From Table 1 above, it is apparent that composites prepared according to the recited processes have substantially improved mechanical properties compared to relevant prior art compositions. The substantial improvement over neat nylon-6 ("Spec. 1" in Table 1) is relevant because, it illustrates the ability to reinforce a high-melting thermoplastic polymer with a temperature sensitive natural fiber without degrading the fiber. The comparisons with the applied references of Medoff and Sato further illustrate substantial improvements in composite strength based on the ability of recited method to process stronger base thermoplastic polymers without degrading the natural fiber reinforcement.

The applicants submit that the foregoing represents a sufficient demonstration of unexpected results for the pending claims. Accordingly, the applicants request reconsideration and withdrawal of the obviousness rejection on this additional basis.

[4] Experiments 4-6, 12, 24-27, 31-35, and 41-43 of Examples 1-6 are presented for comparison because they contain all four of the essential components of Sato's disclosure.

CONCLUSION

In view of the foregoing, entry of amendments to claims 1, 10, 18, and 22, cancellation of claim 6, reconsideration and withdrawal of the rejection, and allowance of all claims 1, 2, 4, 5, 7, 9-15, and 17-22 are respectfully requested.

Respectfully,

Ian C. McLeod
Registration No. 20,931

IAN C. McLEOD, P.C.
2190 Commons Parkway
Okemos, Michigan 48864

Telephone: (517) 347-4100
Facsimile: (517) 347-4103
Email: ianmcld@comcast.net